OIPE IAP45
MAR 24 2006
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Docket No.: 325772036000
(PATENT)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:
Takeshi ISHIDA

Application No.: 10/799,597 | Confirmation No.: 8279

Filed: March 15, 2004 | Art Unit: 3651

For: SHEET MEASURER AND FOLDER (as amended) | Examiner: P. H. Mackey

SUBMISSION OF VERIFIED TRANSLATION OF PRIORITY DOCUMENT

MS Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

This application claims priority under 35 USC 119 to Japanese patent application no. 2003-067752, filed on March 13, 2003. Pursuant to 35 USC 119, a certified copy of said patent application was submitted on March 15, 2004, thereby perfecting the priority claim.

In support of the Applicant's claim for priority, filed herewith is a verified translation of the above-identified priority document.

It is respectfully requested that the receipt of the document attached hereto be acknowledged in this application.

In the event that the transmittal letter is separated from this document and the Patent and Trademark Office determines that an extension and/or other relief is required, Applicant petitions for any required relief including extensions of time and authorizes the Commissioner to charge the

cost of such petitions and/or other fees due in connection with the filing of this document to **Deposit Account No. 03-1952** referencing 325772036000.

Dated: March 24, 2006

Respectfully submitted,

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VERIFICATION OF TRANSLATION

I, Motohiro Makino, 4-6-1-604, Nyoidani, Minoh, Osaka, Japan, hereby declare that I am conversant with the English and Japanese languages. I further declare that to the best of my knowledge and belief the following is a true and correct translation of Japanese Patent Application No.JP2003-067752.

Date: March 22, 2006

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Document title: Patent application

Serial number: 188145

Date filed: March 13, 2004

Submitted to: Commissioner of Patents

International patent classification: B65H 37/04

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Fees:

Prepayment ledger number: 013262

Amount paid: 21,000 yen

List of submitted items:

Item: Specification 1

Item: Set of drawings 1

Item: Summary 1

Comprehensive letter of attorney number: 0113154

Proofing: Required

Document Title

Specification

Title of the Invention

Sheet binding method and second sheet processing apparatus

Claims

1. A sheet binding method including the steps of:

conveying a sheet forward along a conveyance path;

detecting the trailing edge of the sheet using detection means having a detection position on said conveyance path;

stopping the conveyance of the sheet after said detection step;

conveying the sheet backward along said conveyance path and detecting the trailing edge of the sheet once more using said detection means;

after the detection of the trailing edge, continuing the backward conveyance of the sheet by a prescribed amount corresponding to the sheet length along the direction of conveyance and stopping the sheet;

creating a fold line in the sheet using a sheet folding unit disposed on said conveyance path;

conveying the sheet forward and supplying it to a stapling tray after said fold line creation step;

accumulating a plurality of sheets on said stapling tray while aligning the trailing edges thereof to form a packet of sheets; and

moving a stapler and the packet of sheets relative to each other based on the sheet length along the direction of sheet conveyance and stapling the packet of sheets together using said stapler.

2. A sheet binding method including the steps of:

conveying a sheet forward along a conveyance path;

stopping the sheet when the trailing edge thereof is at a prescribed position on said conveyance path;

conveying the sheet backward along the conveyance path by a prescribed amount corresponding to the sheet length along the direction of conveyance after said stopping step;

creating a fold line in the sheet using a sheet folding unit disposed on said conveyance path;

conveying the sheet forward and supplying it to a stapling tray after said fold line creation step;

accumulating a plurality of sheets on said stapling tray while aligning the trailing edges thereof to form a packet of sheets; and

moving a stapler and the packet of sheets relative to each other based on the sheet length along the direction of sheet conveyance and stapling the packet of sheets together using said stapler.

3. A sheet binding method including the steps of:

measuring the length along the direction of conveyance of a sheet that is guided along a conveyance path;

conveying the sheet forward along said conveyance path;

detecting the leading edge of the sheet using detection means having a detection position on said conveyance path;

continuing the forward conveyance of the sheet by a prescribed amount corresponding to the sheet length along the direction of conveyance that is measured in the previous step and stopping the sheet;

creating a fold line in the sheet using a sheet folding unit disposed on said conveyance path;

conveying the sheet forward and supplying it to a stapling tray after said fold line creation step;

accumulating a plurality of sheets on said stapling tray while aligning the trailing edges thereof to form a packet of sheets; and

moving a stapler and the packet of sheets relative to each other based on the sheet length along the direction of sheet conveyance and stapling the packet of sheets together using said stapler.

4. The sheet binding method according to any of Claims 1 through 3, wherein said prescribed amount is set such that the distance between the trailing edge of the sheet and the part at which the fold line is created equals half of the specification sheet length.

5. A second sheet processing apparatus that has a mode in which said apparatus binds together a packet of sheets comprising a plurality of sheets supplied from a first sheet processing apparatus using the sheet binding method according to any of Claims 1 through 4.

Detailed Description of the Invention

[0001]
Field of the Invention

The present invention relates to a second sheet processing apparatus that performs second processing of sheets onto which images have been output by a first sheet processing apparatus such as a copying machine, printer or multifunction peripheral combining the functions of a copying machine and a printer. The present invention also relates to a sheet

binding method using which a plurality of sheets, in each of which a fold line has been created, are accumulated and formed into a packet, which is then stapled.

[0002]
Description of the Related Art

As a second sheet processing apparatus (finisher) installed next to a first sheet processing apparatus such as a copying machine, an apparatus has been proposed in the conventional art that makes a fold line at the center of each sheet supplied from the first sheet processing apparatus, accumulates such sheets [into a packet] and center-binds the packet of sheets by driving staples into the fold lines of the packet of sheets (see Patent Document 1, for example).

[0003]

Using this second sheet processing apparatus, a fold line is created [in the sheet] using a sheet folding unit disposed in the conveyance path while the leading edge (the first edge) of the sheet introduced into the second processing apparatus is held in place using a regulating plate, the conveyance of the sheet is then reversed (i.e., the sheet is ejected from the sheet folding unit with the trailing edge (the second edge) advancing first) such that the sheet is conveyed on a reverse path, and the sheet is ejected onto a tray. A plurality of sheets are accumulated in this way and a packet of sheets is formed. Subsequently, after the grouped sheets are aligned along the first edges of the sheets using a regulating plate, the packet is conveyed to a stapling position, at which staples are driven into the fold lines.

[0004]

Incidentally, sheets vary in size. For example, landscape-oriented A4-size sheets (i.e., sheets whose length is perpendicular to the direction of conveyance) have a width falling within the range of 210 ± 2mm. As a result, where each sheet is folded using the first edge as a reference point, for example, and stapling is carried out with the packet of sheets positioned using the second edge as a reference point, the staples may be driven into an area that is offset from the fold lines. In contrast, using the construction of the conventional apparatus described above, because folding and stapling are both performed after the packet of sheets is positioned using the first edge as a reference point, staples can be driven into each fold line even if the sheets vary in size.

[0005]

[0006]
Problem Addressed by the Invention

In the conventional art, the second sheet processing apparatus is generally installed next to the first sheet processing apparatus comprising a copying machine or the like, but in recent years, a compact image processing system has been proposed that is composed of a first sheet processing apparatus and a second sheet processing apparatus, wherein at least part of the second sheet processing apparatus is disposed within the first sheet processing apparatus, enabling the footprint of the second sheet processing apparatus to be reduced.

[0007]

However, when the second sheet processing apparatus has a binding mode including a center-binding mode in which a fold line is created in sheets and staples are driven into the fold lines, in order for the fold line creation process and the stapling process to use the same sheet or packet edge as a positioning reference point, a reverse path must be included as described in Patent Document 1, for example, inevitably increasing the size of the system.

[0008]

Therefore, an object of the present invention is to provide a binding method that enables the image processing system to become more compact in size based on the second sheet processing apparatus.

[0009]

Another object of the present invention is to provide a second sheet processing apparatus that has a mode in which packets of sheets are bound according to the binding method described above.

[0010]
Means to Resolve the Problem

In order to attain these objects, the sheet binding method of the present invention according to a first aspect thereof comprises a sheet binding method including the steps of:

conveying a sheet forward along a conveyance path;

detecting the trailing edge of the sheet using detection means having a detection position on the conveyance path;

stopping the conveyance of the sheet after the detection step;

conveying the sheet backward along the conveyance path and detecting the trailing edge of the sheet once more using the detection means;

after the detection of the trailing edge, continuing the backward conveyance of the sheet by a prescribed amount corresponding to the sheet length along the direction of conveyance and stopping the sheet;

creating a fold line in the sheet using a sheet folding unit disposed in the conveyance path;

conveying the sheet forward and supplying it to a stapling tray after the fold line creation step;

accumulating a plurality of sheets on the stapling tray while aligning the trailing edges thereof to form a packet of sheets; and

moving a stapler and the packet of sheets relative to each other along the direction of sheet conveyance based on the sheet length and stapling the packet of sheets together using the stapler.

[0011]

Using this sheet binding method, folding and stapling are performed after positioning of the sheet or packet of sheets using the trailing edge as a reference point, but because each sheet is first conveyed forward and then backward on the conveyance path and is then further conveyed forward for supply to the stapling tray, it is not necessary to have a reverse path, resulting in a more compact second sheet processing apparatus.

[0012]

The sheet binding method of the present invention according to a second aspect thereof comprises a sheet binding method including the steps of:

conveying a sheet forward along a conveyance path;

stopping the sheet when the trailing edge thereof is at a prescribed position on the conveyance path;

conveying the sheet backward along the conveyance path by a prescribed amount corresponding to the sheet length along the direction of conveyance after the stopping step;

creating a fold line in the sheet using a sheet folding unit disposed in the conveyance path;

conveying the sheet forward and supplying it to a stapling tray after the fold line creation step;

accumulating a plurality of sheets on the stapling tray while aligning the trailing edges thereof to form a packet of sheets; and

moving a stapler and the packet of sheets relative to each other based on the sheet length along the direction of sheet conveyance and stapling the packet of sheets together using the stapler.

[0013]

Using this sheet binding method, folding and stapling are performed after positioning of the sheet or the packet of sheets using the trailing edge as a reference point, but because each sheet is first conveyed forward and then backward on the conveyance path and is then further conveyed forward for supply to the stapling tray, it is not necessary to have a reverse path, resulting in a more compact second sheet processing apparatus.

[0014]

The sheet binding method of the present invention according to a third aspect thereof comprises a sheet binding method including the steps of:

measuring the length along the direction of conveyance of a sheet that is guided by a conveyance path;

conveying the sheet forward along the conveyance path;

detecting the leading edge of the sheet using detection means having a detection position on the conveyance path;

continuing the forward conveyance of the sheet by a prescribed amount corresponding to the sheet length along the direction of conveyance measured in the previous step and stopping the sheet;

creating a fold line in the sheet using a sheet folding unit disposed in the conveyance path;

conveying the sheet forward and supplying it to a stapling tray after the fold line creation step;

accumulating a plurality of sheets on the stapling tray while aligning the trailing edges thereof to form a packet of sheets; and

moving a stapler and the packet of sheets relative to each other based on the sheet length obtained as a result of measurement along the direction of sheet conveyance and stapling the packet of sheets together using the stapler.

[0015]

Using this sheet binding method, folding and stapling are performed after positioning of the sheet or the packet of sheets using the trailing edge as a reference point (in the fold line creation process, while the sheet is conveyed by a prescribed amount after the detection of the leading edge, because the length of the sheet (i.e., the length from the leading edge to the trailing edge) is measured in advance, the same result is obtained as that obtained from positioning using the trailing edge as a reference point), but because each sheet is first conveyed forward and stopped on the conveyance path and is then further conveyed forward for supply to the stapling tray, it is not necessary to have a reverse path, resulting in a more compact second sheet processing apparatus.

[0016]

By setting the prescribed amount referred to above such that the distance between the trailing edge of the sheet and the area on which the fold line is created equals half of the specification sheet length, center-binding can be performed. According to the first and second aspects [of the present invention], the specification sheet length is set based on user input, for example. According to the third aspect [of the present invention], the specification sheet length is set based on a sheet length obtained as a result of measurement (i.e., for example, the specification length closest to the measured sheet length is obtained as a result of calculation).

[0017]

The second sheet processing apparatus according to the present invention has a mode in which a packet of sheets is bound using the sheet binding method according to any of Claims 1 through 3 with regard to a plurality of sheets supplied from the first sheet processing apparatus.

[0018]

Using this second sheet processing apparatus, a reverse path is not necessary as described above, enabling the apparatus to be made compact in size.

[0019]

Detailed Description of the Preferred Embodiments of the Invention

Embodiments of the present invention are described below with reference to the accompanying drawings. In this Specification, terms that indicate a direction (such as 'up', 'down', 'right' and 'left' as well as other terms including any of these terms) are used, but they only mean the direction in the drawings used for the purpose of description of the embodiments, and the present invention should not be construed as limited in any way by these terms.

[0020]

<First embodiment of binding method>

Fig. 1 shows the entirety of an image processing system 2. This image processing system 2 has a first sheet processing apparatus (hereinafter 'first processor') 4 and a second sheet processing apparatus (hereinafter 'second processor) 6. In this embodiment, the first

processor 4 comprises a copying machine that reproduces an original document image on a sheet, and includes an automatic document feeder 8 disposed on a housing comprising the outer view of the system 2, as well as an optical system 10 to read each sheet of the original document supplied from the original document supply tray 9 of the automatic document feeder 8 to the original document reading position (not shown). The original document sheet scanned by the optical system 10 is ejected onto an original document ejection tray 11 included in the automatic document feeder 8.

[0021]

The first processor 4 also includes a paper supply tray 12 that is disposed in the lower part of the housing 7 and on which sheets S are stacked, an image forming unit 14 that is disposed around the center of the housing 7 and outputs an images onto a sheet based on the image data obtained from reading the original document sheet, a conveyance system 16 that conveys each sheet from the paper supply tray 12 to the second processor 6 via the image forming unit 14, and other components.

[0022]

The second processor 6 is a finisher that performs second processing regarding sheets that have undergone first processing by the first processor 4, such as creation of a fold line at a prescribed area of the sheet and stapling a prescribed number of sheets that are stacked together. In the example of the drawing, a part of the second processor 6 is disposed between the optical system 10 and the image forming unit 14 of the first processor 4, and the other part protrudes from the left wall of the housing 7.

[0023]

According to this image processing system 2 described above, prescribed first processing (such as image formation) is performed as to the sheet in the first processor 4. The sheet that has undergone this first processing is then supplied from the first processor 4 to the second processor 6, where the sheet is subjected to a fold line creation process, stapling process and other processes.

[0024]

The construction of the second processor 6 is described in detail with reference to Figs. 2 and 3, as well as Fig. 1.

[0025]

As shown in Fig. 1, the second processor 6 has a first conveyance path 20 that extends straight from right to left within the housing. Along the first conveyance path 20 are disposed, sequentially from the upstream side toward the downstream side relative to the direction of sheet conveyance, a pair of fist conveyance rollers 22, which are located near the rightmost end of the first conveyance path 20 and conveys sheets ejected and received from the first processor 4, a sensor 23 that detects sheets, a pair of second conveyance rollers 24, a punch unit that punches a hole in a prescribed area of each sheet (the construction of the punch unit is not described in this Specification), a sheet folding unit 28 that creates a fold line in each sheet, a pair of third conveyance rollers 30 and a pair of fourth conveyance rollers 32, which are located near the leftmost end of the first conveyance path 20.

[0026]

As shown in detail in Fig .2, the sheet folding unit 28 includes a pair of sheet folding rollers 34 that can rotate forward or backward and are disposed such that the line connecting the rotational axes thereof is parallel to and slightly below the first conveyance path 20, as well as a pusher member 36 the tip of which can be advanced in the direction perpendicular to the first conveyance path 20 toward the vicinity of the nipping area of the rollers 34. The rollers 34 and pusher member 36 are connected to and driven by a bi-directional motor 38.

[0027]

In this embodiment, the first and second conveyance rollers 22, 24 are connected to and driven by a bi-directional common motor 40. One of the second conveyance rollers 24 is connected to the motor 40 via a clutch 42. As a result, the second conveyance rollers 24 are kept stationary while the motor 40 is being driven, permitting the sheet S to be guided to the sheet folding unit 28 after correction is made regarding the angling of the sheet by having the leading edge of the sheet come into contact with the nipping area of the second conveyance rollers 24.

[0028]

In this embodiment, the third and fourth conveyance rollers 30, 32 are connected to and driven by a bi-directional common motor 44.

[0029]

The motor 38 is a DC motor that is controlled by a controller 46. On the other hand, the motors 40, 44 are stepping motors and rotate in a step-like fashion in accordance with pulses input from the controller 46. Detection signals from the sheet detection sensor 23 are also input to the controller 46. Furthermore, information regarding the specification sheet length L0 of the sheet that is subjected to second processing in the second processor 6 (where a 210 mm x 297 mm A4 sheet is conveyed such that the length of the sheet is parallel to the direction of conveyance, L0 = 297 mm) is sent to the controller 46 from the first processor 4 based on user instruction.

[0030]

Returning to Fig. 1, a second conveyance path 50 that extends straight and downward in an angled fashion from left to right is disposed below and to the left of the fourth conveyance rollers 32. A regulator member 52, which is used to align the edges of a plurality of sheets ejected onto the second conveyance path (stapling tray) 50 as described below, is disposed below and to the right of the fourth conveyance rollers 32 and at the rightmost end of the second conveyance path 50. As shown in detail in Fig. 3, a collating mechanism 54, which comes into contact with the top surface of the sheets that fall from the first conveyance path 20 to the second conveyance path 50 and conveys the sheets toward the regulator member 52 to reliably bring the edge of each sheet into contact with the regulator member 52, is disposed above and close to the rightmost end of the second conveyance path 50. This collating mechanism 54 includes a continuous-loop belt 56 and rollers 58, 60 that support the belt 56. When the driving roller 58 rotates in the direction of the arrow in the drawing, the driven roller 60 that is in contact with the sheet via the belt 56 rotates as indicated by the other arrow in the drawing, whereby the sheet is brought into contact with the regulator member 52. When the packet of sheets S1, which are aligned at their edges, is conveyed upward in an angled fashion along the second conveyance path 50 from right to left (hereinafter the 'second forward direction'), as described below, the driven roller 60 is retracted from the position at which it comes into contact with the sheets.

[0031]

A stapler 62 that drives staples into the fold lines of the packet of sheets S1 to bind the packet is disposed at the leftmost end of the second conveyance path 50. Between the stapler 62 and the regulator member 52 are located a pair of fifth conveyance rollers 64, which is disposed such that they face each other across the second conveyance path 50 and convey the packet of sheets S1 along the conveyance path 50 in the second forward direction. The upper fifth conveyance roller 64 can be retracted from its position close to

the second conveyance path 50 such that it does not interfere with the sheet that falls from the first conveyance path 20 to the second conveyance path 50. The fifth conveyance rollers 64 are connected to and driven by a motor 66. The motor 66 is a stepping motor and moves in a step-like fashion in accordance with pulses input from the controller 46.

[0032]

The stapler 62 includes a head 68 that is disposed below the second conveyance path 50 and drives staples into the packet of sheets S1, as well as an anvil 70 that faces the head 68 and helps bind the packet of sheets S1 by bending the staples that have pierced the packet. The head 68 and the anvil 70 can each move back and forth between positions at which they clamp the packet of sheets and positions at which they are separate from each other along a line perpendicular to the second conveyance path 50.

[0033]

A pair of ejection rollers 74 that eject onto the ejection tray 73 the packet of sheets S1 that has been bound along its center line is disposed near the leftmost end of the second conveyance path 50. The upper ejection roller 74 can move in accordance with the thickness of the packet of sheets S1 while it presses down on the packet. The ejection rollers 74 are also used together with the fifth conveyance rollers 64 to convey the packet of sheets S1 along the second conveyance path 50 in order to set the packet at a prescribed position relative to the stapler 62.

[0034]

Referring to Fig. 1, the tray 76 disposed such that it protrudes from the left wall of the housing 7 is used for the ejection of sheets or packets of sheets that have been subjected to first and second processing in the image processing system 2 using a mode other than the center-binding mode.

[0035]

The operations of the second processor 6 having the above construction while in the center-binding mode will now be explained with reference to Fig. 4-7 as well as Fig. 1-3.

[0036]

First, in step S401, the sheet S that has undergone the first processing is guided into the second processor 6. The sheet S is conveyed along the first conveyance path 20 until the sheet detection sensor 23, which is disposed upstream from the sheet folding unit 28

relative to the first forward direction, detects the trailing edge of the sheet (steps S402, S403) (see Fig. 6(a)). In step S404, the controller 46 causes the first through fourth conveyance rollers 22, 24, 30, 32 to stop rotation in response to a signal from the sheet detection sensor 23. As shown in Fig. 6(a), when the rollers are stopped, the trailing edge of the sheet S has passed the detection position P1 of the sheet detection sensor 23. The controller 46 causes the first through fourth conveyance rollers 22, 24, 30, 32 to rotate in the reverse direction such that the trailing edge of the sheet S passes the detection position P1 of the sheet detection sensor 23 (steps S405, S406) (see Fig. 6(b)), and after the sheet S has been conveyed in the direction opposite from the first forward direction by an amount L1 (step S407), the controller 46 stops the rotation of the first through fourth conveyance rollers 22, 24, 30, 32 (step S408) (see Fig. 6(c)). The amount L1 by which the sheet S1 is conveyed in the reverse direction is calculated based on the specification sheet length L0 specified by the user via, for example, a display panel (not shown) included in the image processing system 2, and the distance L2 between the fold position P2 of the sheet folding unit 28 (i.e., the position on the first conveyance path 20 facing the nipping area of the folding rollers 34) and the detection position P1 of the sheet detection sensor 23 using the formula L1 = L0 / 2-L2. This L1 is constant at all times regardless of variations in sheet size. The controller 46 inputs a prescribed number of pulses to the motors 40, 44 based on the value of L1 to cause the first through fourth conveyance rollers 22, 24, 30, 32 to rotate by a prescribed rotational angle in order to move the trailing edge of the sheet S to the right (i.e., in the reverse direction) by the prescribed amount L1. Alternatively, it is also acceptable if the rotational speed of the motors 40, 44 is held constant during conveyance of the sheet S in the reverse direction, and the controller 46 controls the driving time of the motors 40, 44 based on the value of L1, such that the trailing edge of the sheet is moved in the reverse direction by the amount L1.

[0037]

As described above, in the fold line creation process, the sheet is positioned using the trailing edge thereof as a reference point.

[0038]

With regard to steps S404, S405, if another sheet detection sensor is disposed upstream from the sheet detection sensor 23 such that the trailing edge of the sheet is first detected by this detection sensor during conveyance in the first forward direction, the controller 46 can control the motors 40, 44 in response to the detection signal from the

upstream sensor and stop the sheet while the trailing edge thereof is at the detection position P1 of the sheet detection sensor 23.

[0039]

The second processor 6 performs the fold line creation process in step S409. Specifically, with reference to Figs. 2 and 6(d), with the sheet S at a prescribed position (the area of the sheet that is a distance L0/2 away from the sheet trailing edge is placed at the fold position P2) the controller 46 controls the motor 38 such that the pusher member 36 moves down toward the nipping area of the folding rollers 34 and the folding rollers 34 rotate in the directions of the arrows in the drawings. At the same time, the first through fourth conveyance rollers 22, 24, 30, 32 are caused to rotate in the directions of the arrows in Fig. 6(d) while holding the sheet S. As a result, the sheet S becomes pushed by the pusher member 36 into the nipping area of the folding rollers 34 while it is grasped by the folding rollers 34, whereby a fold line is created in the sheet S.

[0040]

Subsequently, the controller 46 controls the motor 38 to cause the folding rollers 34 to rotate in the reverse direction. At the same time, the controller 46 moves up the pusher member 36. Furthermore, the controller 46 causes the first through fourth conveyance rollers 22, 24, 30, 32 to rotate forward to convey the sheet in the first forward direction along the first conveyance path 20 and eject it onto the second conveyance path 50 (step S410). When this happens, the upper fifth conveyance roller 64 is positioned away from the second conveyance path 50 (i.e., is located at the position shown by the dotted line in Fig. 3).

[0041]

Referring mainly to Fig. 3, the first sheet that has been ejected from the first conveyance path 20 via the fourth conveyance rollers 32 (see Fig. 1) is conveyed down to the right along the second conveyance path 50 due to its own weight and stops at the position at which the leading edge thereof is in contact with the regulator member 52. The second sheet is then ejected onto the second conveyance path 50, following the first processing, via the fourth conveyance rollers 32 after a fold line is created therein in the same manner as with the first sheet. The second sheet slides down at an angle to the right by its own weight over the first sheet. When this happens, the belt 56 of the collating mechanism 54 comes into contact with the top surface of the second sheet while rotating and reliably moves the edge of the second sheet to the regulator member 52, whereby the

first and second sheets are collated. By repeating these operations, i.e., the operations of steps S401-S410, for the third sheet onward, a prescribed number of sheets become accumulated on the second conveyance path 50 (step S411) (see Figs. 3 and 7(a)). The upper fifth conveyance roller 64 then becomes pressed onto the top surface of the packet of sheets S1. The controller 46 causes the fifth conveyance rollers 64 and/or ejection rollers 74 to rotate, and after moving the trailing edge of the packet of sheets S1 in the second forward direction by a prescribed amount L4 such that the position of the fold lines of the packet of sheets S1 match the stapling position P3 of the stapler 62 (i.e., at which staples are driven), stops the rotation of the fifth conveyance rollers 64 and the ejection rollers 74 (step S412) (see Fig. 7(b)). This amount of conveyance L4 is calculated based on the distance L5 between the regulator member 52 and the stapling position P3 along the second conveyance path 50 and the sheet specification length L0 using the formula L4 = L5 - L0/2. L4 is constant at all times regardless variations in sheet size. The controller 46 inputs a prescribed number of pulses to the motor 66 and/or the motor not shown that drives the ejection rollers 74 based on the value of L4 such that the fifth conveyance rollers 64 and/or ejection rollers 74 rotate by a prescribed rotational angle in order to move the trailing edge of the packet of sheets S1 by the prescribed amount L4 in the second forward direction. Alternatively, it is also acceptable if the rotational speed of the motor 66 and/or the motor that drives the ejection rollers 74 are held constant during conveyance of the packet of sheets S1 in the second forward direction, and the controller 46 controls based on the value of L4 the period of time during which these motors are driven such that the trailing edge of the packet of sheets S1 moves in the second forward direction by the amount L4.

[0042]

In step S413, the head 68 and the anvil 70 of the stapler 62 are driven to center-bind the packet of sheets S1 by driving staples into the fold lines in the approximate center thereof.

[0043]

As described above, the stapling process is performed with the packet of sheets positioned using the trailing edge thereof as a reference point. Therefore, because the sheet or the packet of sheets is positioned using the trailing edge both for the stapling and fold line creation processes, staples can be reliably driven into the fold lines even if the sheet size varies.

[0044]

Finally in step S414, the ejection rollers 74 rotate and eject the center-bound packet of sheets to the tray 73.

[0045]

According to this embodiment, the specification sheet length L0 of the sheet being conveyed is obtained via user input, but it is also acceptable if the specification sheet length is calculated based on the signals from the sheet detection sensor 23 and the number of pulses input to the motor 40. Specifically, the sheet detection sensor 23 detects the leading edge of the sheet being conveyed on the first conveyance path 20 in the first forward direction and then the trailing edge thereof. (As described above, the conveyance of the sheet is stopped after the detection of the trailing edge). The controller 46 can measure the actual length of the sheet by counting the number of pulses input to the motor 40 between the detection of the leading edge and the detection of the trailing edge. The specification sheet length L0 of the sheet being conveyed is then calculated based on this actual measurement value and a predetermined threshold value range. (As an example, where the actual measurement value is within the threshold value range of 294 mm-300 mm, such as where the actual measurement value is 298mm, for example, the length of A4 size paper, which is 297 mm, is adopted as the specification sheet length L0.)

[0046]

<Second embodiment of binding method>

A second embodiment of the binding method pertaining to the present invention will now be explained with reference to Figs. 8-10. The construction of the second processor 6 that performs binding using this binding method is essentially identical to that shown in Figs. 1-3 except as described below. Description is provided below with reference to Figs. 1-3 where appropriate.

[0047]

According to this embodiment, the actual length of the sheet (i.e., the length along the direction of conveyance) is measured by the first processor 4 in advance (step S801). Specifically, a sheet detection sensor 80 (see Fig. 1) is disposed at an appropriate position on the conveyance path of the conveyance system 16 such that the sheet leading edge and trailing edge are detected, and the sheet length L6 (such as 298 mm, for example) is measured by counting the number of pulses input to the stepping motor (not shown) that

drives the conveyance rollers of the conveyance system 16 between the detection of the leading edge and the detection of the trailing edge.

[0048]

The controller 46 (see Fig. 2) calculates the specification sheet length L0 of the sheet being conveyed based on the actual measurement value L6 and a predetermined threshold value range. (For example, where the actual measurement value L6 falls within the threshold value range of 294m-300mm, the length of A4 size paper, which is 297 mm, is adopted as the specification sheet length L0.)

[0049]

The sheet, which has undergone the first processing, is guided into the second processor 6, wherein it is conveyed along the first conveyance path 20 in the first forward direction (steps S802, S803).

[0050]

According to this embodiment, after the leading edge of the sheet S passes the detection position P1 of the sheet detection sensor 23 (step S804) (see Fig. 10(a)), the controller 46 causes the leading edge of the sheet S to be conveyed in the first forward direction by a distance L7 = L6 - L0/2+L2 from the detection position P1 such that the fold position P2 matches a position that is distanced from the trailing edge by a distance L0/2 (step S805), and stops the rotation of the first through fourth conveyance rollers 22, 24, 30, 32 (step S806) (see Fig. 10(b)).

[0051]

A fold line is then created in the sheet S by the sheet folding unit 28 in the same manner as described in connection with the first embodiment (step S807) (see Fig. 10(c)). According to this embodiment, the fold line creation process is carried out in this way with the trailing edge of the sheet as a reference point, and even if there are variations in sheet size, a fold line is created at a position a distance L0/2 away from the trailing edge in the first forward direction at all times.

[0052]

The sheet is then ejected onto the second conveyance path 50 (step S808) in the same manner as described in connection with the first embodiment. By repeating the operations of steps S801-S808 with regard to a prescribed number of sheets (step S809), a

plurality of sheets are accumulated on the second conveyance path 50 with the trailing edge of each sheet in contact with the regulator member 52 (see Fig. 3). The packet of sheets is then conveyed to the stapling position of the stapler 62 using the fifth conveyance rollers 64 and the like by a prescribed amount (equivalent to *LA* of the first embodiment) (step S810), and staples are driven into the fold lines (step S811).

[0053]

As described above, stapling is carried out with the packet of sheets positioned using the trailing edge thereof as a reference point. Therefore, because the sheet or the packet of sheets is positioned using the trailing edge for the stapling and fold line creation processes, staples can be reliably driven into the fold lines even if the sheet size varies.

[0054]

Finally in step S812, the ejection rollers 74 rotate and eject the packet of sheets onto the tray 73.

[0055]

Although the present invention has been fully described in connection with the preferred embodiments thereof, the present invention is not limited to these embodiments and may be modified or improved in various ways. For example, in the embodiments described above, description was provided based on a center-binding mode using which the fold line is created in the approximate center of the sheet, but the present invention includes embodiments in which a fold line is created in a different area of the sheet and staples are driven into this fold line.

[0056]

In addition, in the stapling process, the packet of sheets S1 is moved to the stapler 62 in the embodiments described above, but a construction may be used wherein the stapler 62 moves along the second conveyance path 50 toward the packet of sheets S1, or both the stapler 62 and the sheet S1 move toward each other.

[0057]

Furthermore, the sheet folding unit 28 is not limited to the construction explained in connection with the embodiments. For example, in the embodiments described above, the folding rollers 34 rotate forward to make a fold line in the sheet and then rotate backward to release the sheet S from the clamped condition, but if semicircular rollers having a

construction in which part of a circular circumference is removed are used as the folding rollers, the sheet can be clamped and then released while the semicircular rollers continue to rotate in the same direction.

[0058]

In addition, according to the embodiments described above, stepping motors are used as motors 40, 44, 66 that cause the first through fifth conveyance rollers 22, 24, 30, 32, 64 to rotate and to stop, but servo motors such as motors with an encoder may be used instead.

[0059]

The specific embodiments described above include an invention having any of the following construction.

(1) A second sheet processing apparatus including:

conveyance means that conveys a sheet forward and backward along a conveyance path;

detection means that detects the sheet on the conveyance path;

conveyance control means that controls the conveyance means such that the sheet is conveyed backward along the conveyance path after the trailing edge of the sheet is detected by the detection means during conveyance of the sheet in the forward direction by the conveyance means, and after the detection means detects the trailing edge of the sheet once more, the backward conveyance of the sheet is continued by a prescribed amount corresponding to the sheet length along the direction of conveyance and is then stopped;

a sheet folding unit that is disposed in the conveyance path and creates a fold line in the sheet after the backward conveyance of the sheet has stopped by the conveyance control means;

a stapling tray on which the sheets supplied from the conveyance path are accumulated such that the trailing edges thereof are aligned, thereby forming a packet of sheets;

packet conveyance means that conveys the packet of sheets formed on the stapling tray in a prescribed direction;

a stapler that drives staples into the packet of sheets conveyed by the packet conveyance means; and

stapler control means that controls the packet conveyance means and the stapler such that the stapler and the packet of sheets move relative to each other based on the length of [the path] along the sheet conveyance direction and staples are driven into the packet of sheets by the stapler.

(2) A sheet second processing apparatus including:

conveyance means that conveys a sheet forward and backward along a conveyance path;

conveyance control means that controls the conveyance means such that the sheet is conveyed forward by the conveyance means and is stopped when the trailing edge thereof is at a prescribed position on the conveyance path, and the sheet is then conveyed backward by a prescribed amount corresponding to the sheet length along the direction of conveyance and is then stopped;

a sheet folding unit that is disposed in the conveyance path and creates a fold line in the sheet after the backward conveyance of the sheet has stopped;

a stapling tray on which the sheets supplied from the conveyance path are accumulated with the trailing edges thereof aligned, thereby forming a packet of sheets;

packet conveyance means that conveys the packet of sheets formed on the stapling tray in a prescribed direction;

a stapler that drives staples into the packet of sheets conveyed by the packet conveyance means; and

stapler control means that controls the packet conveyance means and the stapler such that the stapler and the packet of sheets move relative to each other based on the

length of [the path] along the sheet conveyance direction and staples are driven into the packet of sheets by the stapler.

(3) A sheet second processing apparatus including:

measurement means that measures the length along the direction of conveyance of the sheet guided onto a conveyance path;

conveyance means that conveys the sheet forward along the conveyance path;

detection means that detects the sheet on the conveyance path;

conveyance control means that controls the conveyance means such that after the leading edge of the sheet is detected by the detection means during the forward conveyance of the sheet by the conveyance means, the forward conveyance of the sheet is continued by a prescribed amount corresponding to the sheet length measured by the measurement means along the direction of conveyance and is then stopped;

a sheet folding unit that is disposed in the conveyance path and creates a fold line in the sheet after the forward conveyance of the sheet has stopped;

a stapling tray on which the sheets supplied from the conveyance path are accumulated with the trailing edges thereof aligned, thereby forming a packet of sheets;

packet conveyance means that conveys the packet of sheets formed on the stapling tray in a prescribed direction;

a stapler that drives staples into the packet of sheets conveyed by the packet conveyance means; and

stapler control means that controls the packet conveyance means and the stapler such that the stapler and the packet of sheets move relative to each other based on the length of [the path] along the sheet conveyance direction and staples are driven into the packet of sheets by the stapler.

[0060]

Effect of the Invention

Using the present invention, it is not necessary to include a reverse path or the like [in the apparatus] in order to reliably drive staples into the fold lines regardless of variations in sheet size, and as a result, the second sheet processing apparatus and therefore the image processing system can be made more compact in size.

Brief Description of the Drawings

Fig. 1 shows the basic construction of an image processing system having a second sheet processing apparatus pertaining to one embodiment of the present invention;

Fig. 2 is an enlarged view of the sheet folding unit and surrounding components in the second sheet processing apparatus shown in Fig. 1;

Fig. 3 is an enlarged view of the stapler and the surrounding components in the second sheet processing apparatus shown in Fig. 1;

Fig. 4 is a flow chart showing the first part of [the processing performed according to] the binding method pertaining a first embodiment of the present invention;

Fig. 5 is a flow chart showing the second part of [the processing performed according to] the binding method pertaining to the first embodiment of the present invention;

Fig. 6 comprises drawings showing each operation of the sheet fold line creation process according to the binding method pertaining to the first embodiment of the present invention;

Fig. 7 comprises drawings showing each operation of the stapling process according to the binding method pertaining to the first embodiment of the present invention;

Fig. 8 is a flow chart showing the first part of [the processing performed according to] the binding method pertaining to a second embodiment of the present invention;

Fig. 9 is a flow chart showing the second part of [the processing performed according to] the binding method pertaining to the second embodiment of the present invention; and

Fig. 10 comprises drawings showing each operation of the sheet fold line creation process according to the binding method pertaining to the second embodiment of the present invention.

[Key]

2 Image processing system
4 First sheet processing apparatus
6 Second sheet processing apparatus
20 First conveyance path
22, 24, 30, 32, 64 Pair of conveyance rollers
23, 80 Sheet detection sensor
28 Sheet folding unit
50 Second conveyance path
62 Stapler

DRAWING

FIG. 2

46 CONTROLLER

FIG. 3

46 CONTROLLER

FIG. 4

CENTER-BINDING PROCESS

S401 GUIDE SHEET INTO SECOND PROCESSOR
S402 CONVEY SHEET FORWARD ALONG FIRST CONVEYANCE PATH
S403 SHEET TRAILING EDGE DETECTED?
S404 STOP CONVEYANCE
S405 CONVEY SHEET BACKWARD ALONG FIRST CONVEYANCE PATH
S406 SHEET TRAILING EDGE DETECTED ONCE MORE?
S407 CONVEY SHEET FURTHER BACKWARD BY AMOUNT L1
S408 STOP COVNEYANCE
S409 FOLD LINE CREATION PROCESS
S410 SUPPLY SHEET TO SECOND CONVEYANCE PATH

FIG. 5

S411 SHEET IN WHICH FOLD LINE IS TO BE CREATED EXISTS?
S412 SUPPLY PACKET OF SHEETS TO STAPLER
S413 STAPLING PROCESS
S414 EJECT TO TRAY
END

FIG. 6

(a) FORWARD DIRECTON

(b) BACKWARD DIRECTION

FIG. 8

CENTER-BINDING PROCESS
S801 MEASURE SHEET LENGTH
S802 GUIDE SHEET INTO SECOND PROCESSOR
S803 CONVEY SHEET FORWARD ALONG FIRST CONVEYANCE PATH
S804 SHEET LEADING EDGE DETECTED?
S805 CONVEY SHEET FURTHER FORWARD BY AMOUNT L7
S806 STOP COVNEYANCE
S807 FOLD LINE CREATION PROCESS
S808 SUPPLY SHEET TO SECOND CONVEYANCE PATH

FIG. 9

S809 SHEET IN WHICH FOLD LINE IS TO BE CREATED EXISTS?
S810 SUPPLY PACKET OF SHEETS TO STAPLER
S811 STAPLING PROCESS
S812 EJECT TO TRAY
END

FIG. 10

(a) FORWARD DIRECTION

Title of the Document

Abstract

Summary

Object

A binding method that enables the second sheet processing apparatus to be made compact in size is provided.

Means

First, the sheet S is conveyed forward along a conveyance path, and after the trailing edge of the sheet is detected by a sensor 23, the conveyance of the sheet is stopped (see Fig. (a)). The sheet is then conveyed in the reverse direction along the conveyance path, the trailing edge of the sheet is detected once more by the sensor 23 (Fig. (b)) and following this detection of the trailing edge, the backward conveyance of the sheet is continued by a prescribed amount corresponding to the length of the sheet along the direction of conveyance and the sheet is stopped (see Fig. (c)). A fold line is then created in the sheet by a sheet folding unit 28 disposed in the conveyance path (see Fig. (d)). The sheet is then conveyed forward and supplied onto a stapling tray, wherein a plurality of sheets are accumulated with the trailing edges thereof aligned, thereby forming a packet of sheets. A stapler and the packet of sheets are moved relative to each other based on the length of the sheet along the direction of conveyance and staples are driven into the packet of sheets using the stapler.

Selected drawing

Fig. 6